Combustion Synthesis of Thermoelectric Materials for Deep Space Exploration

Completed Technology Project (2017 - 2021)

Project Introduction

Over the past decades NASA has commonly used radioisotope thermoelectric generators (RTGs) as a power source for deep space missions. Recently, an RTG was also used in Curiosity Mars rover. In these devices, radioactive decay generates heat, which is then transformed to electric power in thermoelectric (TE) converters. Because of the low supply of radioactive materials that are currently used by NASA, there is an urgent need for improving the performance of RTGs. One pathway for this is to use more efficient thermoelectric materials in RTGs. The goal of the proposed project is to create materials with superior thermolelectric properties using combustion synthesis. Specifically, it is proposed to focus on the fabrication of tin selenide (SnSe), copper selenide (Cu2Se), and lead telluride (PbTe), and use the so-called mechanical activation-assisted self-propagating high-temperature synthesis (MASHS). The research objectives are: 1. To investigate the feasibility of fabricating SnSe, Cu2Se, and PbTeâˆ’based materials with improved TE properties via mechanical activation-assisted self-propagating high-temperature synthesis (MASHS). 2. To investigate pressureless sintering of the obtained materials and compare with different types of sintering such as hot pressing, spark plasma sintering, and shockwave consolidation. 3. To determine thermophysical and thermoelectric properties of the obtained materials.

Anticipated Benefits

The goal of the proposed project is to create materials with superior thermolelectric properties that will improve the performance of radioisotope thermoelectric generators (RTGs), which are commonly used as a power source for deep space missions.

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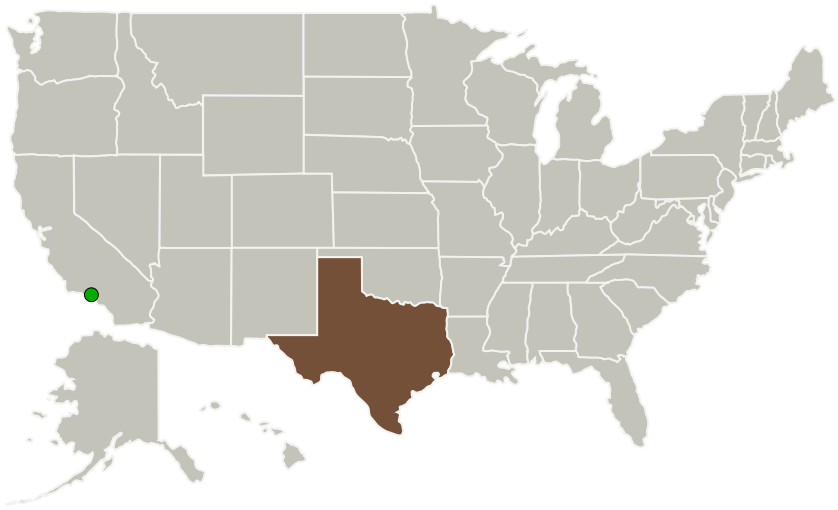
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
The University of Texas at El Paso	Lead Organization	Academia Hispanic Serving Institutions (HSI)	El Paso, Texas
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
Texas

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

The University of Texas at El Paso

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Evgeny Shafirovich

Co-Investigator:

Sergio Cordova

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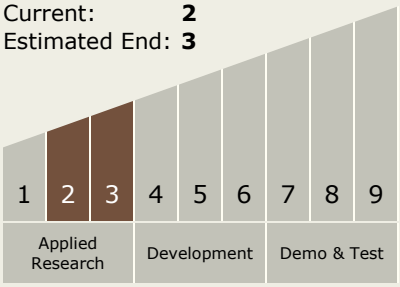
Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines

Target Destinations

The Moon, Mars, Others Inside the Solar System